

# Earth-Heated Nebraska Greenhouse

Brian and Zoe Vakoc are looking forward to picking lemons and avocados in their earth-heated greenhouse. They have already enjoyed mid-winter greens and sitting in the greenhouse when the weather is cold outside. They are also looking forward to fresh fish from their aquaculture system.

Vakoc credits Russ Finch for the concept. Finch developed a greenhouse design warmed by air drawn through in-ground flexible tubing (Vol. 37, No. 2).

"I visited with Russ but made a few changes as I wanted more height and width for trees and an aquaculture system," says Brian Vakoc. "I also shifted slightly off the path the sun travels in winter, giving us a full day of light. In the summer, the sun travels over the top of the greenhouse, providing more indirect heat."

Other changes in the Finch design include a narrow flat roof that holds thermostat-controlled louvers, as well as louvers lower on the rear wall for increased airflow.

"The cold hasn't been as much of a threat as excess heat on warm, sunny days," notes Vakoc.

Vakoc installed a manifold system in the ground with the idea of storing excess heat from the ceiling and then drawing it back in as needed at night. He stacked concrete blocks in four locations in the 250-ft. loop



Vakoc's greenhouse interior with front bed, aquaculture system and rear bed vegetation, far right.

of fourteen 4-in. corrugated black pipes. He laid a drain field cover over the blocks to reinforce them.

The idea was that if one or more of the pipes between manifolds got plugged, the air from the others would mix in the cement block voids and then continue through the next section of 14 pipes.

The pipes have proven more than adequate to supplement heat from the sun in the 25 by 55-ft. greenhouse. Finch's most popular design is 72 by 17 ft. wide. Vakoc's extra width gives him room for two 4-ft. wide vegetable beds front and rear and about 19 ft. between for trees on one half and an

aquaculture system on the other. Vakoc also left room for a 3 1/2-ft. walkway between the front bed and the aquaculture system.

He used 2 by 6-in. boards for framing the rear wall with iron cross supports. It is insulated with dense foam between the uprights.

The first 5 1/2 ft. of the rear wall is vertical with the next 13 ft. angling in slightly to peak at 18 1/2 ft. just north of center. The front face of Lexan Thermoclear is framed with 2 by 2-in. studs with 1 by 1 1/2-in. purlins.

"The front face is one slope with no curvature to it," says Vakoc. "It's more vertical than Finch's to capture more solar heat around the winter solstice."

The east and west walls were framed with wooden 2 by 6's. Vakoc fabricated three windows using Lexan Thermoclear. Like the overhead louvers, they open automatically with an actuator.

The flat roof is about 2 1/2 ft. wide and covered with metal roofing from an old corn crib.

"The aquaculture system consists of one large ICB tote for a fish tank. Four ICB totes with gravel will eventually hold plants, with a bell siphon to raise and lower water levels, as well as 55-gal. barrels as a water reservoir," says Vakoc. "We're still tweaking the pump."

The vegetable beds are poured concrete walls with earthen floors. The front bed is 26 in. wide with the top lower than the outside ground level. The rear bed is 4 ft. wide with its top about a foot below the outside surface. Both are about 24 in. above the surface the trees are planted in.

Vakoc uses a 10-in. fan to push air through the tubes when additional heat is needed. No



Pipes and concrete block manifold in trench.

fan is run during warm weather on the advice of Bill Ihm, a Finch greenhouse owner in western Nebraska.

"Bill helped me a lot with my learning curve," says Vakoc. "He shared that he had left his fan running in the summer, and the warm, humid air condensed when it hit the cool surface inside the tubes. His tubes filled with water, and he had to dig them out and put in new tubes."

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Over time, the Kirk brothers developed a morel soil composed of five different natural products in a precise ratio with a carefully adjusted mineral content.

## How Danish Brothers Learned To Cultivate Morels

At \$50 to \$100 or more per pound, commercial year-round morel production is the Holy Grail of the mushroom industry. However, despite more than 100 years of research, until now no controlled method of indoor production of morels has ever been developed.

Twin brothers Jacob and Karsten Kirk in Denmark have been working on the problem since 1986. In cooperation with the University of Copenhagen, they have developed a method that appears to work.

So far, they have successfully cultivated 92 out of 102 identified genetic variants of the black morel. Two are the most productive, yielding slightly more than 20 lbs. of morels per sq. meter per year with an average size just under an ounce.

What the Kirks have done so far is outlined in detail on their website. It describes their 45-year interest in mushrooms and morels in particular.

By 2004 they had successfully grown black morels in an outdoor location. In the autumn of 2005, they produced black morels in cultivation boxes, yielding 349 grams per sq. meter.

Over time, they developed a morel soil

composed of five different natural products in a precise ratio with a carefully adjusted mineral content. They also discovered that the entire unit had to be in ecological balance. This includes growing grass in the beds as part of the cultivation process, as well as climate control.

Other developments include designing the cultivation units. They now have stackable Rako boxes in pallet form for easy moving.

Helena Kirk of the Danish Morel Project responded to FARM SHOW's request for current plans to commercialize and how it would be done, as well as the cost of a system. "Nothing is determined yet," she says.

One thing The Danish Morel Project has not done is patent its process. In 2006 they began the application process but were advised it could easily be circumvented. Instead, they have kept the key points of their process secret and provide only limited information.

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**Gourmet Mushroom**  
Growing Your Own Morel Mushrooms

Morel Habitat Kit - Grow Morel Mushrooms

Grow the "food to eat" White Morel mushrooms. Complete instructions for preparing and maintaining your Morel Mushroom Grow Kit are included.

Each kit is designed for a 4 by 4-ft. bed and contains 22 oz. of morel spawn.

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## Grow Your Own Morel Mushrooms

James Malachowski has been selling morel mushroom kits for more than 30 years so nothing surprises him anymore. Sometimes his kit produces a bucket of mushrooms the first year and sometimes nothing happens at all.

"I had two people in a Michigan suburb who were best friends and neighbors order kits, and they did the same thing with both kits," recalls Malachowski of Gourmet Mushroom Products. "The next spring, one harvested 70 morels, and the other had nothing."

"If you plant the kit in spring or early summer, you are most likely to get some the next spring," says Malachowski. "It takes at least a year to establish. While production varies from area to area, the second year tends to be the best."

Malachowski only shares a few of the details of establishing a bed of morels with non-customers. To get the full list of instructions, you have to buy his kit for \$34.95. Each kit is designed for a 4 by 4-ft. bed and contains 22 oz. of morel spawn.

"You need a definite transition from winter to spring for morels to grow," he says. "I try to discourage people from areas that don't have a true spring from buying a kit. That said, I have had people from Alaska to the deserts of the Southwest grow them."

Another hint he offers is to feed the morel bed fresh kitchen green waste. "Mix it into the soil on regular basis until a month or two before you expect them to produce," he says.

The company website suggests each kit can produce pounds of morels, even in the first year Malachowski notes that one customer reported getting 120 morels in year 15.

However, when asked, his answer suggests reality may be quite different. "On average, people get from 5 to 20 or 30, and that won't be every year," he says. "Getting 100 or more is rare."

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